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MILITARY ENGINEERING

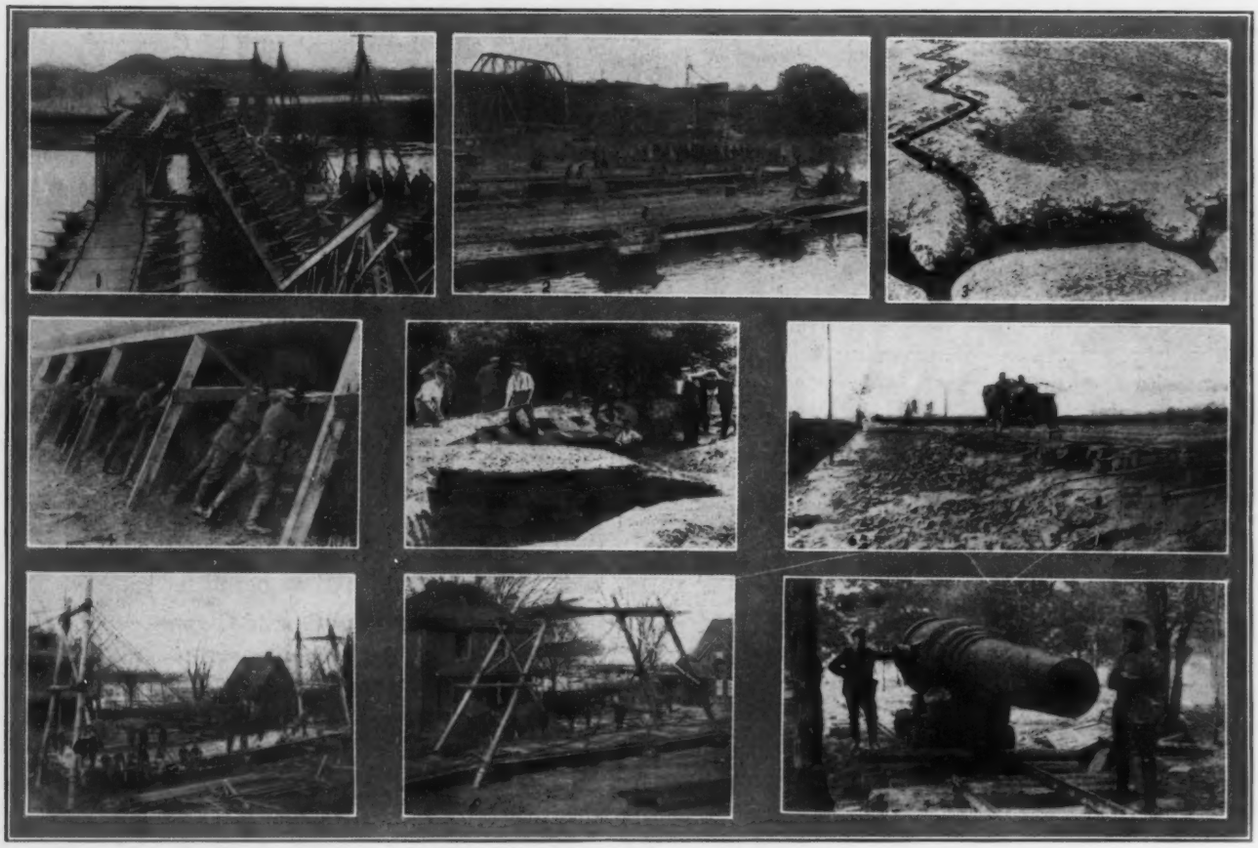
BY CAPTAIN RICHARD PARK,
Corps of Engineers, U. S. Army.

(This article is an abstract of a paper read before the Engineer's Club of San Francisco, March 6, 1916. It deals with the problem in general and specifically with civil engineering conditions. The concluding portion, to be published next week, discusses matters of electrical interest.—The Editor.)

Modern warfare is essentially an engineering problem. Engineers of one class or another have designed and constructed the great guns and mortars of the artillery, the powerful rifles and machine guns of the infantryman. They have invented and perfected the automobile and the autotruck, made possible the telephone, the telegraph, and the wireless, and have built the roads and the railroads over which armies and their supplies must be moved. Engineers are responsible for the devices and for the transportation facilities that make warfare on a vast scale possible, and make it so terrible.

Justly therefore are they called upon to play an important role in campaign and on the field of battle. It has long been recognized that technical troops form a necessary part of modern armies. The technical troops of our army consist of the Signal Corps, the Ordnance Department and the Engineer Corps.

According to the provisions of the U. S. Army regulations the Corps of Engineers is charged with



Military Engineering Construction Feats.

(1) Ponton Replacing Dynamited Bridge Across Vistula River, (Photo. Illus. Press Co.); (2) Practice Ponton Construction; (3) Zizzag Trench Alignment, (Photo. Underwood and Underwood; (4) Trench Protection with Steel Plates on Timber Frames; (5) Typical Trench Construction; (6) Corduroy Road, (Photo. Illus. Press Co.); (7) Double Lock Trestle Bridge; (8) Suspension Type Bridge; (9) Track Construction for Big Guns, (Photo. Underwood and Underwood.)

reconnoitering and surveying for military purposes, including the laying out of camps, the construction and repair of fortifications, the installation of electric power plants connected with seacoast batteries, the design and operation of field searchlights, and the planning of defensive and offensive works of troops in the field. Within the theatre of operations in time of war it has charge of the construction and repair of wharves, roads, ferries, bridges and incidental structures, and of the operation of armored trains. They further conduct preliminary examinations and surveys for river and harbor improvements and execute such of these works as are authorized by Congress —and also such other duties as the President or Congress may order.

About the only military engineering carried on in time of peace with which the general public is familiar is the construction of seacoast defense works. The fortifications are constructed by the engineers so far as purchase of sites, concrete work, parapets, cover, power plants, and electrical installations are concerned. The guns are mounted by the Ordnance Department, the Signal Service installed by the Signal Corps and the batteries turned over to the Coast Artillery for manning. The seacoast batteries at the entrance to San Francisco Harbor illustrate this class of work. Due to the features, such defensive works must be constructed in time of peace.

Military Map Making.

One of the most important duties of the Corps of Engineers is that of military map making. They should bend every energy to get the money and the personnel necessary and provide accurate maps of theatres of operation before war comes. They must in time of war often make up for a lack of these by mappings as they march in the face of hostile armies, for which work of course only men trained in peace time in the principles of surveying will be of use. Those who are topographers, surveyors, draftsmen, computers, photographers, road engineers, landscape engineers and the like will in time of war find ample use for their profession, both preparing reconnaissance maps of probable battle areas, working with the advance guard of the fighting forces, and also preparing by more accurate methods maps of probable theatres of operation not yet attacked by the enemy.

Why should it not be a proper preparedness movement for engineers skilled in map making and reconnaissance work in the use of the transit, level, computers' tables, and drafting instruments to place their names on a paper organization as military topographers, ready to report for mapping duty on the outbreak of war. Should war break out tomorrow, threatening the west coast, the unmapped or poorly mapped portions of California, Washington and Oregon, would be immediately surveyed under the direction of engineer officers. Such work would require the organization of hundreds of mapping parties using thousands of topographers and thousands of surveying instruments of all kinds. Money would be provided in plenty for doing this work. How quickly and efficiently our start could be made if we had prearranged working plans for the work.

There have been lessons in war teaching the value of accurate military maps of a theatre of operations.

In Natal in January, 1900, the ignorance of the topographical details of a comparatively small area cost thousands of lives. The country between the Upper Tugela and Ladysmith, although it had been in British possession for upwards of half a century, was unsurveyed and unknown.

In many battles during the Civil War officers and troops maneuvering into position lost their way on account of faulty maps.

The Japanese owed much of their success in the Russo-Japanese war to the fact that they had prepared before the war, excellent maps of much of the Manchurian country, and to the fact that they had captured excellent Russian maps of the rest of the theatre of war.

The deadlock on the western front of the European war today is due primarily and directly to the fact that both sides have accurate military maps of the war theatre. For years these maps have been in their posssession and have always been kept up to date. From a study of these maps and a study of the ground covered by these maps during the years preceding 1914, the chiefs of each army knew every essential topographical characteristic of the frontier region and deep stretches east and west. Utilizing these splendid maps, the French and Germans for years before the war fought possible battles on paper. The war chiefs of France and the general staff of Germany each figured in secret what measures the other could take to oppose attacks at all possible points portrayed on their maps and with different numbers of troops. Each on his own frontier practiced these battles in maneuvers. Through years of such study every possible solution of each of those problems was studied out on paper by the use of maps and proper plans were made beforehand for their working out in actual war. Each army knows that the other army is well acquainted with all these solutions. The element of surprise is therefore largely done away with, and the armies of the opposing forces being of the same potential strength and equally well led—the deadlock ensues and the struggle becomes one of resources. Think of where France would have been today, had Germany had these maps of her own country and of France, and made these solutions of map problems in time of peace, and France been without the maps and the studies which they permitted!

Laying Out of Camps.

Taking up now the laying out of camps, the Engineer Officer must know the number of troops he has to provide for and the amount of room necessary for the camp of each organization of the command. The general location for the camps will be chosen from the map by the officer in command of the troops, but it will be the duty of his engineers to select the definite camp sites, designate the places for obtaining drinking water, water for cooking and for animals, also the places where bathing and washing clothes will be allowed.

He must get the advice of medical officers as to the fitness of water for drinking purposes. If unfit in its original state proper arrangements must be made for filtering, or sterilizing it.

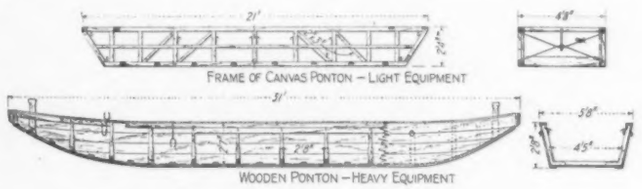
It is very important that proper sanitary arrangements be provided for at the very beginning of the

occupation of a camp. It is just as important that pure drinking water, protection from flies and mosquitoes, and proper sanitary arrangements be provided for a one or two nights' camp as for a semi-permanent camp of long duration. In a short camp very simple but nevertheless adequate sanitary measures suffice, while in a larger permanent camp, will be found modern water supply systems, and elaborate sewage disposal plants.

When a camp is to be occupied during the winter season in a cold climate, it will be necessary for the engineers to design and supervise the construction of housing arrangements more substantial than tents. Huts would be built in this country out of lumber or galvanized iron which the Quartermaster Department would be called upon to furnish.

Movement of Troops.

Next comes the work of the engineers with the mobile troops, in connection with the transportation and movement of the armies. This has to do with the construction, repair and maintenance of roads within the theatre of operations, and bridges, ferries, forts, water transportation, railroads, and other facilities necessary for the rapid and uninterrupted movements of troops. Road and bridge work is most important in an offensive campaign where the march is through territory recently abandoned by the retreating enemy, who has done everything possible in the way of destruction of transportation facilities. It is the function of the engineer troops with the advance guard, to clear away obstructions, repair bridges, pro-



Canvas and Wooden Pontons.

vide ferries, in short to do everything possible to enable the troops in rear to keep on the march. Such work must then be performed with all possible speed. Our bridge outfit consists of a heavy and light train. The light train contains the necessary equipment to construct a substantial roadway supported on canvas boats or pontoons made up of collapsible forms and rectangular pieces of heavy canvas. Enough boats, balks, and flooring must be carried with the advance troops to insure the spanning of the widest stream. The light bridge will pass cavalry on infantry, the regular wagon trains and light artillery. The heavy train uses heavy wooden pontoons and heavier balks or stringers, and is of a strength sufficient to carry the heaviest trains likely to be found with an army.

It would be impracticable to carry enough portable bridge material to span many wide streams at the same time, so just as soon as the necessary material can be collected these floating bridges are replaced by trestle, pile or suspension bridges, or by other floating bridges using boats and barges found on the stream, and timbers cut in the forests or furnished from the rear. The released bridge train is then dismantled, loaded up and rushed to its proper place near the head of the column. The pontoons of the bridge trains in addition to their use as floating piers in a substantial bridge are employed as single boats for the transportation of the head of the column to the opposite bank, or in groups of two or three, furnished with flooring and used as rope or trail ferries.

An enterprising enemy in retreat will endeavor to blow up or otherwise obstruct a road-bed in addition to demolishing culverts and bridges. A great deal of damage can be done by explosives to roads through marshy areas by destroying the road-bed. This will call for corduroying or temporary repair by brush work before wagons can be passed. In defiles, roads can be blocked by explosives blowing in huge masses of the adjacent hillside or cliff. A road cut along the precipitous sides of a ravine or cliff can be effectively blocked by dynamiting the road-bed into the ravine below, necessitating the bridging of the gap, or the cutting deeper into the cliff before the traffic can be resumed. A tunnel can be completely blocked by the judicious use of dynamite. Roads through forests can be blocked by felling trees across them.

The speed with which the engineer overcomes such obstacles and opens up the road again will be a measure of his efficiency. There is no time to draw up elaborate plans for reconstruction. He must decide at a glance as to how best to go about the work of repair. He may see at once that the destruction is so complete that that particular route can not be opened up in time to be of any value, and that the army behind must choose another road. Generally, however, he finds a way to get through. If a tunnel through a mountain spur is blocked, he sees that there is a chance to dig and blast a road around the spur, making use of all the troops as they come up. If a high trestle across a canyon is gone, he at once picks out a possible ramp down one side and a site for the ramp up the other side. Possibly he can with less delay construct a suspension bridge, using the wire cable and tools in his tool wagons, and the growing timber near at hand. The culverts can usually be replaced either by filling with brush and earth, or by felling trees for stringers and using poles and brush for the flooring. Ravines up to 45 ft. wide can be spanned rapidly by means of the single lock or double lock spar bridge, built of logs felled near by, and the frame-work lashed together with the manila rope carried as a part of the equipment. Fords get rapidly cut up and rendered impassable by the passage of the army trains. They may be obstructed by the enemy, placing therein harrows with spikes turned upward, by wire entanglements, or by dynamite. The solution is to find another ford nearby and prepare the approaches, or by means of brush mattresses and fascines again make the damaged ford passable.

These temporary and makeshift repairs by the engineers with the advance guard, are improved by the rest of the engineer troops with the mobile army, in order to facilitate the transportation of reinforcements and supplies, and as the army continues to advance and the roads and bridges first repaired are left well in rear and come under the control of the commander of the line of communications, it is the duty of his engineers to improve the roads, open up the tunnels and replace the improvised bridges with more permanent structures.

Skilled practical engineers are needed in this class of work, not only for the design but for the actual construction. The army engineer in charge of the repair of destroyed works wants trained subordinates from the next in command down to the man who handles the riveting machine or the road scraper. If his engineer officers are trained civilians who have been bridge engineers, hydraulic engineers, highway engineers, mining engineers, construction engineers, if his soldiers are recruited from civilians trained in practical engineering construction work, naturally the bridge will be replaced, or the road, canal, drainage system reconstructed, the tunnel opened up—in a better, more substantial way, and in quicker time, than if his officers are recruited from lawyers and ministers, and his soldiers from farm-hands or garment workers. Bridge-builders, machine men, highway engineers, irrigation and hydraulic engineers, mining engineers, in short, construction engineers of various classes, could organize in some way so that their special qualifications can be made use of in time of war, with the engineer troops who will be assigned this class of work.

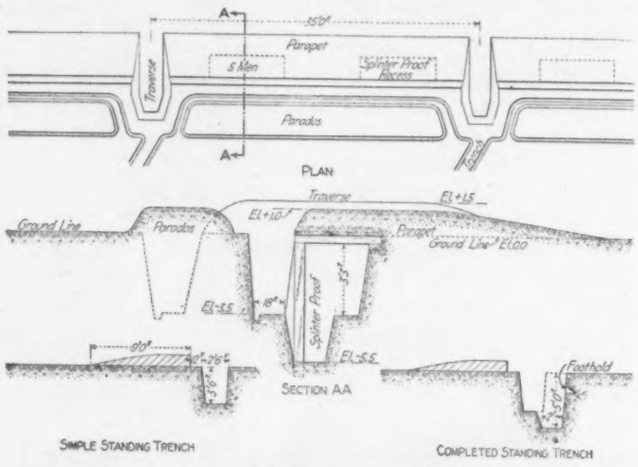
It is hardly the function of the engineers with the advance troops to repair railways, except in so far as such work helps along or is necessary in connection with road work. Railroads are useless without rolling stock and this the enemy will have demolished or taken with him in his retreat, and it would be impossible for advance troops to put a demolished railroad in such repair as to be of any aid in the transportation of the main forces a day's march in rear. Such of the engineer troops as are not needed with the advance forces are however at once put to work repairing the railroad, with such material as can be found in the vicinity. All that can be done by the field battalions is of material aid to the work of the base battalions, who are charged with the construction and maintenance and operations of railroads connecting the main bases with the advance bases. For this work there will be organized railroad battalions, composed of regular and volunteer engineer troops, recruited from civilian locomotive engineers, firemen, mechanics, etc.

Field Fortification.

By law the Corps of Engineers is also charged with the planning and superintendence of construction of defensive works of troops in the field—which means Field Fortification. Field fortification is divided into hasty intrenchments, deliberate intrenchments and siege works. Hasty intrenchments are defined as constructed by troops usually under fire, in an effort to increase or prolong their fighting power. Deliberate intrenchment comprises works constructed by troops not in line of battle, for the protection of depots, lines of communication, supply, or retreat. Siege works comprise devices used by besiegers and besieged in the attack and defense of strong fortifications.

Less than two years ago it was generally believed, except possibly by Germany that the simple standing trench with a parapet 10 ft. to 12 ft. thick with sufficient head overhead cover to resist shrapnel and shell fragments would be safe against destruction by artillery fire. It was believed that, due to the inconspicuous target, the percentage of hits would be so small and the amount of damage inflicted to any one hit so little that the amount of ammunition required to destroy an earthwork or render it untenable, would be prohibitive. The Germans in the first stage of the Great War, realizing all this, attacked the French and English works with shrapnel and high explosive shell from 3 in to 7 in. in diameter, in such astounding quantities from seemingly inexhaustible supplies, that the leveling of the old type of field work was an easy task. It did not take the allies long to acquire on their side, too, a vast number of guns and howitzers of small and large calibre and a supply of ammunition sufficient to destroy enemy works in preparation for an infantry assault.

The tremendous effect of modern field artillery fire has had its influence upon the constructional features. While the general types have remained unchanged, there is now a tendency to make the trench



Typical British Trench Construction.

very narrow in order to present as small a target as possible in the direction of the enemy's fire, and to increase the number of traverses, thus decreasing the length of each section, and localizing the effect of bursting shells. On the other hand, the underground features have been greatly elaborated, due to the necessity for giving the men as much shelter as possible when they are not actually manning the parapet. These features vary all the way from the simple recesses excavated under the parapet of the firing trench to more elaborate works such as tunnels dug between the firing trenches to the cover trenches in rear, or the bomb-proofs of the cover trenches where men may rest safe from anything except the heaviest shells or mine explosions.

The engineers with the mobile troops are not generally called upon to construct the hasty intrenchments; they are dug by the troops who occupy them, and in our army, infantry, cavalry and artillery troops are supplied with tools for this purpose. Engineer officers and soldiers will, however, be called upon to superintend the development of the hasty trench into types that partake more and more of the character of deliberate works. They will be called upon to furnish the tools and the material for the construction of the trench drainage systems, the sanitary arrangement, and other devices in the firing trenches. They will be responsible for the planning and construction of the cover trenches located from 25 to 100 yards in rear of the firing line where considerable protection has to be provided, and they

supervise the digging of the communicating trenches.

The engineers are called upon to design, lay out and construct the deliberate intrenchments necessary in rear of the first line trenches. Such works vary all the way from a single small redoubt defending a stream crossing, to the carefully concealed and elaborately designed series of trenches and redoubts of the second and third lines. These lines on both the east and west fronts of the great war are hundreds of miles long, and you can imagine what their construction has meant in the way of design, superintendence, labor and material.

In close relation to these works there have been carried on by the mobile engineers the railroad, highway and bridge work necessary to complete an elaborate and efficient system of communications between different sectors of the long lines and between all sections of the lines and the central bases.

The particular field fortification devices that were formerly supposed to be used only in connection with sieges or the investment and attack of a permanent fortification, are parallels, approaches and mining operations. Parallels are simply intrenchments dug parallel to the line of defense. The first parallel is dug as soon as the artillery fire of the defense has been sufficiently brought under control. This is a broken line completely circling the fort or forts invested at a distance of about 1200 yards. From the first parallel zigzag trenches, called approaches, saps, or zigzags, are dug toward the enemy and their ends connected by the second parallel 500 yards or so from the enemies' works. From this parallel zigzags or saps are again thrown out to within 300 yards or so of the defense and a third parallel constructed. This third parallel will usually be the position from which the assault will be made. While this surface warfare of trenches and saps is going on the attack is engaged in tunnelling and mining operations underground with a view to firing mines under the walls of the defense and thus providing an opening through which the assault can be made. The defense meanwhile endeavors by counter mines to destroy the galleries dug by the attack, and to demolish their surface works.

The siege of Port Arthur was carried on by the Japanese quite according to the text. In the first days of the present war, however, we saw great fortresses believed to be impregnable, destroyed by a few days' artillery fire from guns and howitzers the like of which we had not known to exist. Apparently it will not be necessary in the future to resort to the slow process of siege works in the capture of fortresses not armed with artillery superior to any that can be brought against it.

Siege works have in former wars been largely confined to attacks on permanent fortifications. Today we see all the devices of siege warfare in use on both fronts against field intrenchments. In former times a siege entailed first the surrounding of the place by mobile troops, so as to cut off supplies and reinforcements, then the preparation of intrenchments, lines of communication in rear, including roads, railroads and rivers, the establishing in position of batteries of siege guns, and then the surface and underground attack by means of saps and zigzags and mines, artillery bombardment, and infantry and cavalry assault. Oftentimes in former wars a place besieged would be protected on one side by water, and the attack would have to be made by water on that side.

In the world war today the central powers constitute a gigantic fortress, in a state of siege. Where they are not hemmed in by land works the navies of the allied powers have more or less completely invested them by water. The land walls of this fortress are the thousands of miles of trenches which are closely invested by similar works of the allies. These trenches are occupied by millions of infantrymen and cavalrymen armed with rifles, hand grenades and machine guns, they are supported by thousands of guns and howitzers with apparently inexhaustible supplies of ammunition. Military railways, canals, rivers, make easy the problem of communication in rear of all fronts. The air scouts spy out the dispositions of the besieged armies. The elaborate telephone and radio systems, quickly transmit all information to the various army headquarters.

In former wars the besiegers generally had to employ greatly superior forces. They had more men, more guns, more ammunition and a stronger navy. Today the allies have more men, probably more guns, and ammunition, and a greatly superior navy. It remains to be seen whether the allies are strong enough to capture the besieged central powers through infantry assaults through vital sections in their lines, or can invest them long enough and completely enough to enforce the capitulation through starvation.

The construction of field fortifications calls for considerable engineering ability on the part of those in charge. A trench dug through hard pan or stiff clay will require but little shoreing up or revetting while a trench through sand or mud will require strong timbering. Due consideration must be given to drainage. Sometimes a gravity system can be devised, regard being given to tactical considerations. Sometimes long stretches of trench must be drained into sumps, and pumps provided to discharge the sump. Suitable water supply arrangements must be designed and constructed.

Competent civilian engineers, enrolled with the army engineers in time of war, will of course have no difficulty in solving the constructional features involved, once the site and type of work has been decided on. Part of his duties with the mobile engineers will be, however, to select or advise the selection of, the location and type of works to be constructed. When these are to be constructed in rear of the first lines and not under fire there will be plenty of time to make a thorough personal reconnaissance of the ground, but when it involves some radical change in the location under fire of a firing trench or the rapid conversion of a captured enemy trench, or of a mine crater just exploded, so as to make it a part of the defensive line, the engineer is called upon to apply his knowledge instantly on the spot. The ability to do this can be obtained only after a thorough study in time of peace of the principles involved.

[To be continued.]

New hydroelectric plants in New Zealand include a 6000 h.p. development at the Wairua Falls north of Auckland and a 58,000 h.p. development at Lake Coleridge, in South Island, about 70 miles from Christchurch.

FEASIBILITY OF WESTERN ELECTRO-METALLURGY.

BY DORSEY A. LYON AND ROBERT M. KEENEY.

Possibility of Success of Electro-metallurgical Industries at The Dalles, Oregon.

It is believed that electric power can be sold profitably by the proposed Columbia River Project at The Dalles for $10 per horsepower year delivered to the electro-metallurgical plant transformers at 11,000 volts. The consumer is assumed to be located at The Dalles within a few miles of the proposed power plant. The price of $10 per horsepower year is based upon that price for each horsepower of generator capacity set aside for the manufacturing plant to supply its maximum demand, i.e. the quotation is a flat rate.

Before considering specific industries which might use The Dalles power, we wish to call attention to the fact that while a company which purchases power from a power company has less initial expenditure to make for its plant than if it developed its own power, it is at a disadvantage in operation of the plant. This is because no power company will contract to sell large blocks of power for less than a term of years except on rigid contract, which compels the electro-metallurgical company to pay for the contracted amount of power whether it uses it or not. This is apt to determine the success or failure of an electro-metallurgical company, for in this industry power is one of the most important raw materials. If a company has to pay for this power in a period of business depression, it may very easily be forced into the hands of the receiver by having to pay for power it does not use. It is far worse than being compelled to store large amounts of ore in a stock yard during depression, because the ore can be used, while electric power purchased under these circumstances can not be used except as made. The power goes down the river, and if the power company did not compel its customers to pay for a contracted amount, it would fail financially.

Aluminum.

The process by which aluminum is produced consists essentially of refining hydrated alumina, bauxite, to make a pure alumina by a chemical process known as the Bayer process, and then feeding this alumina into a bath of cryolite, forming the electrolyte, with the result that when direct current is passed through the molten mass, molten aluminum is deposited at the cathode and oxygen given off at the anode.

Raw materials and labor. The ores and other raw materials necessary to the manufacture of aluminum are bauxite, cryolite, fluorspar, coke or charcoal to make electrodes, and coal and caustic soda for purification of bauxite. Of these materials all except coal and charcoal would have to be brought to The Dalles plant from a distance.

Bauxite is mined in the United States in Alabama, Arkansas, Georgia and Tennessee. Arkansas is the leading producer. A plant located at The Dalles would be obliged to depend for its source of bauxite upon some of these Eastern states, as no bauxite is known to exist in the Western United States in large quantities. It has been proposed by some that alunite might become a source of aluminum, but all processes for the extraction of alumina from silicates are still very much in the experimental stage. About 10 per cent of the bauxite consumed in the United States is imported from Europe. The Southern Aluminum Company with its plant in North Carolina proposed to import all of its bauxite from France during the first few years of operation.

The average price of bauxite per long ton at the mines for 1913 was $4.75 per long ton. A typical bauxite analyses as follows:

Insoluble	12.13 per cent
Loss on ignition	28.97 per cent
Alumina (Al_2O_3)	57.56 per cent
Iron Oxide (Fe_2O_3)	1.34 per cent

About four long tons of bauxite are necessary per ton of aluminum, which will cost at the mine in Arkansas or Georgia, $19. This bauxite if used at The Dalles must be hauled from the east by rail or by rail and water. It is doubtful if raw bauxite would be laid down at The Dalles for less than $14 per ton. The total cost of bauxite at The Dalles per ton of aluminum produced from it would be $56. Four tons of bauxite would produce two tons of alumina. The cost of purification would bring the cost of alumina to $38 per ton of 2000 lb. Two tons of alumina produces one ton of aluminum, so that the cost per ton of aluminum for alumina made at The Dalles would be $76.

Freight could be saved by purification of bauxite to alumina at the mine or nearby. The cost of alumina at the mine would be about $19.50 per short ton, or $28.75 per ton at The Dalles. The alumina for one ton of aluminum would thus cost $57.50 at The Dalles, a saving of $9.25 per ton of alumina, or $18.50 per ton of aluminum made from the alumina.

In the manufacture of aluminum 0.1 tons of cryolite, sodium aluminum fluoride $AlF_3.3\,NaF$, is consumed by volatization of the electrolyte per ton of aluminum made. Cryolite is produced only in Iceland. Some aluminum manufacturers substitute an artificial fluoride for the cryolite, using also some calcium fluoride, fluorspar. Cryolite is worth about $24 per long ton in New York, or 1.1 cents per pound. Shipped to The Dalles cryolite would cost about $35 per long ton or 1.5 cents per pound.

In the electrolysis of alumina in the electric furnace, the oxygen given off at the anode attacks the carbon electrode with the result that about 0.7 lb. of carbon anode is consumed per pound of aluminum produced. In France and Germany these electrodes are manufactured at the larger aluminum plants from coke at a cost of 2.5 cents per pound. The cost of manufacturing them at The Dalles with coke costing $10 per ton or charcoal at $9 per ton would be about 5 cents per pound. Electrodes could be brought from the East or Europe at a cost of 5 to 6 cents per pound f.o.b. The Dalles.

The cost of other materials such as caustic soda or fluorspar will not be discussed here, as the amount used is small, and their cost has been included in other estimates.

Labor costs at The Dalles for manufacture of aluminum will be higher than in the Eastern states or Europe. In Europe $1 per day is an average wage for laborers at aluminum plants, $1.50 in the Eastern United States, and $2.50 in the West outside of mining camps.

Power. The manufacture of aluminum requires direct current so that the use of The Dalles power would mean the transformation of the 11,000 volt current down to a lower voltage for use in a motor generator set. Allowing for transformer, motor, generator and line losses, this would result in the delivery to the furnace from the direct current generator of about 85 per cent of the energy put to the transformers. As the plant would be operating on a flat rate of $10 per horsepower year for 11,000 volt alternating current, the cost of power at the electrolytic furnace on the basis of 100 per cent load factor would be $11.76. While it is sometimes stated that an industry like the manufacture of aluminum can be operated on a 100 per cent load factor, this cannot be used as a safe figure in calculating costs. Manufacture of aluminum, however, will maintain a higher load factor than some other similar industries, as for instance electric furnace manufacture of iron and steel, because of the small units employed and the ease of replacing a broken down unit with a new small one without much additional capital outlay caused by keeping reserve units. The largest aluminum furnaces do not require over 150 h.p. for operation, while electric iron and steel furnaces have a capacity of from 300 h.p. to 12,000 h.p. Another point influencing the load factor maintained is the market for the product manufactured. This is especially true of a new company which has to build up its market. When buying power on a flat rate instead of by the kilowatt hour, with a variation of load factor say between 85 and 100 per cent any curtailment of production due to market conditions will result in a heavy charge to the electro-metallurgical company for power which they are not using. For this reason a load factor of 90 per cent is assumed in calculating the cost of power. This would increase the cost of direct current at the aluminum furnace to $13.06 per horsepower year, or 0.2 cents per kilowatt hour.

Cost of production. Our estimate of cost of production of aluminum at The Dalles is based upon a plant requiring 25,000 h.p. or more in units of 100 to 150 h.p.

Cost of Production of Aluminum per ton (2,000 lb.) at The Dalles.

2 tons of alumina, $28.75 per ton	$ 57.50
200 lb. of cryolite at 1.5 cents per lb.	3.00
1400 lb. electrodes at 5 cents per lb.	70.00
Other fluxes, etc.	10.00
28,000 kw.-hr., at 0.2 cents per kw.-hr.	56.00
Labor	70.00
Repairs	10.00
Amortization, depreciation, 5 per cent each	18.00
Interest, 6 per cent	10.00
General	20.00
Total	$324.50 per ton or 16.22 cents per lb.

Allowing $15 per ton for freight to New York and $20 per ton for marketing expense, the total cost per ton f.o.b. New York would be $359.50 per ton, or 17.98 cents per pound, in round numbers 18 cents per pound.

Market. The aluminum market of the United States is New York City. The average price for No. 1 ingot metal at New York during 1913, generally for spot metal rather than future deliveries, is stated below:

Average Price of Metallic Aluminum at New York City in 1913 in cents per lb.

January	26 1/8—26 5/8
February	25 4/5—26 1/8
March	26 5/10—27 3/10
April	—27 3/8
May	26 3/10—26 3/4
June	24 3/4—25 1/4
July	23 1/8—23 4/5
August	22 7/10—23 3/10
September	—22 3/8
October	—20 6/10
November (first half of month)	19 1/2
November (last half of month)	19 1/6—19 2/3
December	18 7/10—19 3/10

The tariff act enacted in October, 1913, placing a duty of 2 cents per pound on ingot aluminum instead of the previous duy of 7 cents per pound, resulted in the price falling in October of that year to 20 to 20½ cents per pound, and as low as 18 7/10 cents in December. The New York price on September 12, 1914, was 20 to 20½ cents. The above quotations are indicative of transactions in the open market, especially as made by dealers in foreign aluminum. The average price of contract aluminum was 1 to 2 cents per pound less than prices given. Hence it is evident that in order to avoid a shut-down in dull times a company manufacturing aluminum at The Dalles should be able, if necessary, to sell its aluminum in the New York market at a price of 18 cents per pound.

A plant at The Dalles would have competition in the New York market with a domestic production at present of 42,000,000 lb. of aluminum, and imports of about 30,000,000 lb. The domestic production of aluminum will be increased by at least 10,000,000 lb. per annum in 1915 when the Southern Aluminum Company starts its plant, and by 10,000,000 lb. more when the plant is completed. So that inside of two years all of the present imports except 10,000,000 lb. will be supplied by a domestic producer. As the plans of the Aluminum Company of America contemplate doubling their present capacity at a plant in Tennessee, this will eventually add a possible production of 40,000,000 lb. per annum or a total future output of 30,000,000 lb. more than the present market demands. Thus it is clear that any company starting business now will have strong competition to meet in several years, which would be from the very start of its operation, as its plant could not be completed for several years. This competition would exist in spite of the fact that the consumption of aluminum in the United States has increased at the average rate of about 7,000,000 lb. per annum for the last five years. While at this rate of increase of consumption, contemplated increased output would no more than supply the domestic demand, it is not probable that the consumption will maintain quite as high a rate of increase. Foreign manufacturers will also be much more active in the New York market in the future owing to the decreased tariff.

Conclusions. We are of the opinion that the utilization of Columbia River power in the manufacture of aluminum would not prove very profitable to the manufacturing company for several reasons.

While the price of power at $10 per horsepower year, on the 11,000 volt alternating current circuit, is low in cost, the high freight charges on raw materials and product, and increased labor costs over eastern wages, are such as to raise the cost of production so

high that in periods of depressed market the cost of aluminum made at The Dalles would about equal the lowest selling price. Our opinions are further strengthened by the fact that invariably manufacturing costs increase in times of business depression due to decreased output; also as this plant would buy power on a flat rate basis, any decrease in output would result in a great increase of unit cost, due to the continual charge for power regardless of its being used.

A study of the preceding data shows that freight rates on raw materials, supplies and product have contributed largely to the cost of production at The Dalles. While India bauxite might be shipped to The Dalles very cheaply, little is known about these deposits, and their development is in the distant future. An example of the cost of materials due to freight is in electrodes. They can be purchased in the East at 5 cents per pound. On the basis of 0.7 lb. consumption of electrode per pound of aluminum, the cost of electrodes at 5 cents per pound increases the cost of aluminum by 1.4 cents per pound.

Labor cost would also be considerably higher in the West, as previously stated. Technical men in the West such as chemists and engineers also receive a higher rate of pay.

All of these factors have contributed to the raising of our estimate of cost of production to 18 cents per pound f.o.b. New York. At the low price of aluminum in 1913 a company at The Dalles could about break even if it sold its product. At a price of 20 cents per pound a profit of 2 cents per pound would be made. A production of 10,000,000 lb. per annum would require a plant costing about $4,000,000. This production would give a profit of $200,000 per annum, or 5 per cent on the actual investment. We consider this to be much too low a margin of profit for safe investment due to unforseen conditions which might arise and increase the cost. Estimates previous to operation are usually found to be low in practice. It is probable that the Eastern producer could sell at a profit at 18 cents per pound, for it has been estimated that the cost of production of aluminum at Niagara Falls is about 15 cents per pound.

In regard to market conditions, we believe that a new company starting manufacture of aluminum would meet strong competition. The removal of the tariff and the establishment of a plant financed by French capital in the United States has resulted in much competition for the local market. Competition will be still much stronger when plants now in course of construction are completed.

A company now a producer of aluminum with a market for its product and an intimate knowledge of the industry could possibly manufacture aluminum at a small profit at The Dalles, but we can see no advantage for such a company coming to Oregon at the present time or in the very near future, as long as they are able to secure power near the ore and market, as they are able to do at the present time. An established company owning its bauxite supply and having a market is the only sort of a concern which, we believe, would be able to operate without losing money in a plant at The Dalles, and they could not make as much as in an Eastern plant.

[To be continued.]

SOME PROBLEMS OF INDUCTIVE INTERFERENCE.

BY A. H. GRISWOLD, L. P. FERRIS, R. W. MASTICK.

(This paper was presented at a joint meeting of A. I. E. E. and N. E. L. A., Portland, Oregon, January 11, 1916. The discussion thereon will be published subsequently.—The Editor.)

Inductive interference may be defined as the resulting interruption or impairment of service over a communication circuit exposed to the influence of the varying electric and magnetic fields surrounding a neighboring power circuit. Exposure arises from colineally constructed lines constituting what is generally termed a "parallel" or case of "parallelism."

In the above definition of inductive interference, communication and power circuits are both used in a general sense, communication circuit meaning any circuit used for the transmission of intelligence and power circuit including all circuits transmitting relatively large amounts of energy in comparison with the communication circuit. For the purpose of this paper, which is to present certain aspects of this subject for your consideration, the field covered by the above definition has been narrowed so as to include only metallic telephone circuits and power transmission circuits. Even with this limitation, it will be impossible within the scope of this brief paper to do more than touch upon the important features of this problem.

Transient interruptions of service occur in most instances of parallelism between power and telephone circuits, and continuous impairment of service to a large or small extent, is to be expected, unless adequate precautions are observed.

Interruption of service due to the effects of normal steady state operation of a power circuit occurs only under severe or acute conditions. Transient interruptions to service are caused in most instances by such abnormal conditions on the power circuit, as grounds, short-circuits or open-circuits, which largely unbalance the system. In some instances, transient interruptions are produced by such normal operations as switching and the charging of electrolytic lightning arresters. The severe inductive effects resulting from transient disturbances in a power system are oft' times the cause of personal injury to telephone operators and occasionally to subscribers and telephone linemen. In most instances, the injury of operators is due directly to what is familiarly known as a "bat in the ear." In extreme cases, operators have been thus disabled for a period of four months. Aside from personal injury, service is sometimes demoralized by such occurrences which naturally make the operators nervous in performing their duties.

In cases where the disturbance is sufficiently severe to operate the protective devices on the telephone circuits, considerable loss of circuit time is experienced, due to the necessity of replacing the protective apparatus which is generally "blown" simultaneously on a number of circuits and at offices widely remote from the seat of the disturbance.

Abundant statistics are available to show the seriousness of such transient disturbances, but it is desired here merely to call attention to this situation, the seriousness of which will undoubtedly be appreciated without the necessity of burdening this brief paper with statistics.

The remedial measures to prevent such interruptions and damage consist essentially in large factors of safety in the construction of the power circuit and apparatus, and careful maintenance and operation. In cases where line faults develop, the method of location should be arranged in such manner that the fault itself is not energized repeatedly in the process of location, as each time this is done a severe disturbance is liable to be created in neighboring communication circuits. Where possible, switching should be done on the low-tension side of transformers, and the several poles of the switches mechanically inter-connected so as to avoid as far as possible momentary unbalancing of the circuit.

Some methods of charging electrolytic lightning arresters give rise to more severe transient disturbances than others. Charging resistances and the method suggested by the General Electric Company, in the General Electric Review for January, 1913, are recommended. The time of charging arresters can often be arranged for a period when the telephone circuits are least liable to be in use.

Apparently there are no preventative measures which may be employed which will entirely obviate transient interruptions to telephone service where such circuits are paralleled for considerable distances by power circuits.

A continuous impairment of service may result from practically all parallels, due to the normal operating conditions on the power system, unless adequate precautions are taken to the contrary. Such impairment of service is due to the induced currents in the telephone circuits which manifest themselves as noises in the telephone receivers at the terminals of the circuits. You are all doubtless familiar with the humming or singing noise heard on telephone circuits subject to induction, and most telephone circuits on the Pacific Coast are unfortunately so subject to a more or less extent. This impairment of service due to noise is termed continuous, as it continues at all times while the power circuit is in normal operation. The effect of the noise is to decrease the intelligibility of conversation over the affected circuits, thus decreasing their efficiency.

The chief factors which are to be considered in judging the severity of the induction which may be caused by a parallel are:

1. Length of parallel.
2. Separation between circuits.
3. Spacings of conductors of power circuit and of telephone circuit.
4. Configuration of circuits.
5. The magnitude, frequency, and character (whether balanced or residual) of the fundamental and harmonic currents and voltages of the power circuit.
6. Unbalance of power circuit (producing residual voltages and currents).
7. Unbalance of telephone circuits.

The currents and voltages of the power circuit, including harmonics as well as fundamental, may be resolved into what are termed balanced and residual components. Briefly the former are balanced with respect to the earth as a point of reference, the balanced currents, for instance, being confined in the case of a three-phase circuit to the three line conductors and excluded from the earth. In the case of residual components the power circuit as a whole is raised above ground potential, the ground thus forming one side of the circuit, therefore the power circuit is for residuals equivalent to a ground-return single-phase circuit. It should be almost obvious that the inductive effects of residual voltages and currents are proportionately greater than the inductive effects of balanced voltages and currents.

In regard to remedial measures to prevent impairment to service over telephone circuits due to the normal operation of power systems the most obviously effective and desirable method is to avoid or eliminate the parallel. That parallels cannot always be avoided or eliminated is recognized by all concerned. With the recognition of this fact we are confronted with the problem of so constructing and operating parallel telephone and power circuits that each industry may be unhindered in its development and extension of its network of circuits for the benefit of the public.

It is perhaps fortunate and significant that substantially all interference and impairment of service arises from factors which are non-essential to the practical operation of power circuits. These non-essential factors are the residual voltages and currents, fundamental as well as harmonics, and the harmonics of the balanced voltages and currents. The balanced voltages and currents of fundamental frequency, which perform the useful functions of the power system, cause little damage to parallel telephone circuits and this little can be easily prevented by simple measures. Not only are the factors which are the most damaging to neighboring telephone circuits non-essential to the power circuits but they sometimes cause trouble to the power circuits themselves. Under these conditions it is but just and proper that power companies make reasonable efforts to eliminate these non-essential factors which are so troublesome to their neighbors.

The basic cause of noise in telephone circuits subject to induction is the presence of harmonic currents and voltages in the power circuits. Were it not for the irregularities of wave-form of the power circuit voltages and currents there would be practically no noise disturbances due to the vast majority of existing parallels.

Tests have conclusively demonstrated that the detrimental effect of a given amount of extraneous current in a telephone receiver increases very rapidly with the frequency (approximately as the square) up to about 800 cycles per second, beyond which the detrimental effect decreases very gradually. This increase in the detrimental effect with an increase in the frequency of the extraneous current is very largely a physiological phenomena and the relative detrimental effects of equal amounts of extraneous currents of different frequencies may be termed the physiological factor for the weighting of different harmonics in accordance with their power of interference. It is convenient in weighting all the harmonics to use the fundamental as a basis of reference. There are a number of factors which must be considered in linking the telephone receiver to the generator of the distant power station. Some of these factors are: (1) telephone terminal apparatus factor, (2) telephone line factor, (3) induction factor, linking telephone and power circuits and (4) power circuit factor. The product of all these

factors and the physiological factor will give the relative weights, from the standpoint of inductive interference, which should be assigned to the different harmonics originating in the generator. All of these factors are not accurately known but the net result is undoubtedly to increase the importance of the higher harmonics above that assigned to them by the physiological factor alone. For the purpose of this paper these considerations merely show the great importance of efforts to improve the wave-form of alternating current machinery. The attainment in commercial service of pure sine waves is not to be regarded as practicable. However, it is perfectly feasible to better conditions in this respect in new electrical machinery by a due regard to the details of design which determine the magnitude and order of harmonics produced by rotating machines. It is no criticism of the designers that such has not been the case in the past for the importance of such efforts has not perhaps been sufficiently recognized. Much will be accomplished in this direction if users of apparatus impress upon the manufacturers the importance of improving wave-form, especially as material improvements can in many cases be made at a very small expense. Distortion of wave-form with the consequent introduction of harmonics is inherent with the use of iron-core transformers. The importance of transformers as sources of harmonics is chiefly with respect to triple harmonic residuals introduced by grounded star-connected transformers.

With respect to residuals power circuits fall naturally into two general classes:

1. Circuits operated with a grounded neutral or neutrals.
2. Circuits isolated from ground, that is, normally having no metallic connection to ground at any point.

For the first class of circuits the causes of residuals are:

1. The triple harmonic voltages and currents from grounded star-connected transformer banks.
2. Unbalanced loads to neutral.
3. Capacitance unbalance of the several phases of the circuit.

For grounded-neutral systems the characteristic triple-harmonic residuals are most troublesome and difficult to prevent or minimize. Their magnitude is determined very largely by the type of transformer connections and the magnetic density of the transformer iron. Low magnetic density and the delta-star connection of single-phase units or three-phase core-type transformers are to be recommended in preference to high magnetic density and the star-star connection of single-phase units. Observance of these precautions is, however, no guarantee that harmful interference may not result in cases of severe exposure. The effect of the lines and the interaction of banks of transformers at different points of a large grounded neutral network present a complicated problem, the detailed discussion of which has no place in this paper.

To prevent residuals due to unbalanced load careful attention should be given to the distribution of load upon the several phases and in no case should grounded single-phase loads be permitted.

Capacitance unbalance is generally of minor importance in giving rise to residuals in grounded neutral circuits. Should its effect be of importance it can, however, be cared for by transposing the power circuit.

Residual voltages and currents in isolated power systems arise from unbalanced capacitance and conductance between the several phases of the circuit and ground. In well maintained power circuits the effect of unbalanced leakage is of minor importance. In an isolated power circuit the voltages to ground are determined by the voltages between conductors and the capacitances between the several conductors and ground. If the latter are unbalanced the voltages to ground will be unbalanced, that is, they will not sum up to zero and if different sections of line are not similarly unbalanced a residual current will be caused. The unbalanced capacitance of a power circuit can be reduced to a negligible amount by transposing the power circuit in such a manner that each conductor occupies each of the conductor positions for equal distances. In other words, a whole number of "barrels" must be installed. The length of "barrel" necessary to effectively balance the circuit is dependent upon the frequency of the prominent harmonics of the impressed voltages, since it is chiefly desirable to guard against the harmonic residuals.

In all cases of parallelism the power and telephone circuits should be rendered as nearly as practicable mutually non-inductive by the installation of coordinated transposition systems upon which reliance is placed to prevent troublesome interference from the disturbing factors of the power circuit which it is not possible to eliminate.

Each side of a telephone circuit subject to induction is raised above the potential of the ground which must be in the case of telephone as well as power circuits, the true basis of reference. The disturbing current in the telephone circuit is due to the differential inductive effect between the two sides of the circuit. Transpositions in the power circuit reduce the induction from balanced voltages and currents by creating mutually neutralizing inductive effects in neighboring lengths of each side of the telephone circuit. They do not affect the induction from residuals since they do not in reality constitute a transposition of the two sides of the residual circuit. Transpositions in the telephone circuit tend merely to equalize the induction in the two sides of the circuit, whether from balanced or residual components, by exposing each side equally to the effect of the power circuit. Where both power and telephone circuit transpositions are employed the effectiveness of this equalizing depends, with respect to the balanced components, upon the relative location of the power and telephone transpositions and it is for this reason that careful coordination of transpositions in the two types of circuit is essential to the success of the method.

The effective application of coordinated transposition systems to the power and telephone circuits involved in a parallel generally requires power circuit "barrels" of from one-half mile to six miles in length, the former figure being exceptional. The number of power transpositions required is very largely determined by the length of reasonably uniform sections of parallel between points of discontinuity such as ends of parallel, crossovers, substations, loading points and branch loads. In regard to the telephone transpositions, it is generally necessary to completely retranspose the telephone circuits within the limits of the

parallel and beyond each end of the parallel to the nearest neutral point in the transposition system. The development of a special system of telephone transpositions has been necessitated by the double requirement of rendering the telephone circuits non-inductive to the power circuit and to each other.

Considering some of the other factors which determine the severity of induction to be experienced in any given case, it is obviously desirable that the separation between circuits be as great as possible. It is also highly desirable that the separation between circuits be as uniform as possible in order that the effectiveness of transpositions may not be seriously impaired. The spacing of the conductors of the power circuit and telephone circuit is important in determining the magnitude of the inductive effects. The conductors of each circuit should be as close together as practicable in order to minimize the induction. The spacing of the telephone conductors employed in practice is now as small as possible, considered with proper maintenance and operation of the circuits. Cases have occurred in which the spacings of the conductors of the power circuit were greatly in excess of anything demanded by the mechanical or electrical requirements of the situation.

The configuration of the circuits, meaning the relative positions of the different conductors, is a large factor in determining the magnitude of the induction per unit length of exposure. The configuration of telephone circuits is practically fixed and uniform, but, on the other hand, there is some choice with respect to the arrangement of the power conductors. Power engineers have indicated their willingness and desire where possible, to adopt a configuration which will give the minimum of induction. Unfortunately, however, the available knowledge as to the best type of configuration and the relative merits of different practical configurations, is very limited.

The unbalance of a power circuit in producing residual voltage and current has been mentioned before. The unbalance of the telephone circuits themselves is of considerable importance in determining the noise in circuits subject to induction. When a telephone circuit as a whole is raised above ground potential, any unbalance of the circuit tends to cause a current through the terminal apparatus, thereby causing noise. The efforts of the telephone companies since the introduction of metallic telephone circuits have been to steadily improve the balance of their circuits until today little practical benefit in the way of noise reduction can be obtained through efforts in this direction. It should be borne in mind that the requirements of telephone circuit operation, entirely apart from the matter of interference by power circuits, necessitate a very high degree of balance in order to prevent mutual interference between the large number of closely associated telephone circuits on the same pole line.

The fact that power circuit transpositions do not reduce the average induction from residuals into the two sides of a circuit, coupled with the fact that a small voltage to ground may produce harmful interference, even with the high degree of balance attained in telephone circuits, renders it important that an effort be made to attain a similar high degree of balance of power circuits, i.e., the reduction of the residual voltages and currents.

Recent developments in California in regard to the inductive interference situation are of present interest. Owing to the spirit of co-operation between the power and telephone companies due to the work of the joint Committee on Inductive Interference and the adoption by the Railroad Commission of California of the committee's recommendations for rules to mitigate inductive interference; many important induction cases have already been settled amicably and in a manner entirely satisfactory to both parties. The chief benefit of the California rules is perhaps not so much in the rules themselves as in the spirit of co-operation and mutual understanding which has developed as a result of the investigation upon which the California rules are based. It is this spirit of co-operation that should be encouraged between all power and telephone companies, and in which they should meet to overcome the difficulties growing out of inductive interference and adopt remedial measures for the most economic solution of the problem, all things considered, regardless of whether the most extensive changes are necessitated in the system of the power company, or of the telephone company and allowing the division of the costs to be made independently and solely with regard to the equities of the situation.

Electricity at the front is the subject of an article in l'Industrie Electrique, which states that the territory in Belgium and France which is occupied by Germans, is rich in factories, with a great many central station supplying electric light and power. The high pressure mains, the transformer stations, and distributing networks have suffered from the effects of the fighting, but as soon as possible after the district is occupied the mains are put in order, and the electric light is brought into use. As there were stocks of coal at the pit-heads, and the pits that were in good condition have been restarted by the Germans, energy is generated at cheap rates. Even before the large power stations had been restored, ingenious soldiers had brought many small installations into use for lighting houses, and the electric light is almost indispensable for hospitals, operating theatres and dressing rooms, bakeries, railway stations, and offices. With the aid of electric power the Germans have been able to thrash quickly considerable quantities of corn, to drive their workshops, and to carry on a variety of important services. As coal cannot be used at the mines in the neighborhood of hostile artillery for fear of attracting attention by the smoke, winding engines have been driven by electric power. In the stables chaff-cutters have been driven by motors, and the dentists in rear of the front use motors to ply their art. In some cases, places which before the war were not electrically lighted have been provided with installations. The use of electricity at the extreme front line is particularly important. In spite of the difficulty of laying mains to the firing line, electric pumps are often used to clear the trenches of water; electricity has also proved most useful in tunneling for mines quickly and silently, a matter of great importance, besides making it possible to ventilate long and narrow underground galleries. Electric light is also used in the trenches and dug-outs.

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An Example of Public Confidence

The most remarkable feature of the California Railroad Commission's refusal to allow the Pacific Gas & Electric Company to declare a common stock dividend has been the rapid recovery from this attack on the corporation's credit. The unexpected tenor of the decision, amounting to a complete reversal of former policy, temporarily disturbed the stability of all securities, particularly those which were ostensibly to be protected by the decision. But the company's past efforts to comply with the spirit of the commission's requirements has evidently and justly earned public confidence.

Getting Along with the Public

How to live amicably with one's mother-in-law is, on a large scale, the problem that confronts a public utility corporation trying to build better public relations. The very fact that a utility and the public quarrel so readily would seem to prove that they are relations. Just what kind of relations, friendly or otherwise, is largely dependent upon the attitude of the utility. This view is worth analyzing, for it leads to some remarkably simple conclusions.

Fundamentally, the problem of creating better public relations is the same as that of creating better private relations. The great public is merely an aggegate of families, yours, and your neighbor and your neighbor's neighbor, ours, and our neighbor and our neighbor's neighbor. The chief reason why more cordial relations have not been established, that greater confidence does not exist, is because the public has usually been considered in the abstract, as an aggregate, instead of in the concrete, as individuals.

The things that appeal to and govern the action of a child, likewise affect a crowd. The public is human, it has a universal consciousness and an innate sense of fair play. And today the man who would successfully develop a public utility should be a man with human sympathy, human understanding and super-human faith. These qualities are necessary on a small scale in building up the organization, in developing the corporation spirit, and on a large scale in winning and holding public confidence. The individual is a product of the group, and the group a multiplication of individuals.

Every official and employe of a public utility company has the opportunity to be individualistic, to be a leader in thought and initiative, and to demonstrate that not only do the parts exist for the whole but also that the whole exists for the parts. It is necessary for them to cultivate greater insight, sympathy and comradeship and acquire the perspective of true service. This spirit is being truly exemplified by President Lilienthal of the United Railroads at San Francisco, who "dares to be a Daniel."

This macroscopic conception can be attained only by an enlargement of microscopic action. The same actions which arouse trust, confidence and gratitude in the home will stimulate them in the public, just as inevitably as the reverse actions create distrust and hate. A father practices generosity, forgiveness and

patience to bring about obedience, dutifulness and love in the family. The same thought applies to the management of a public utility in its attitude toward the public. Benevolence begets reverence. The scornful mental attitude on the part of the utility engenders an attitude of fear on the part of the public and creates vindictiveness and watchful suspicion. Substitute the spirit of give for the spirit of take and the public will eventually reciprocate.

The one point in which society in general differs from an integration of family units is that the larger group is without the family bonds. The larger the group the greater is the lack of warm personal feeling. To maintain social harmony it is necessary to find some other bond, to appeal to some other motive, such as that of self interest.

Teach the public that private initiative and responsibility in public utilities is to the best interest of the community. By the exercise of imagination about a city's needs, sympathy with a district's development and loyalty to a territory's cause, stimulate similar ideals in the public mind as regards the utility's part in public progress. Nail every lie about the corporation as soon as it is uttered. And finally, and most important, maintain persistent and consistent publicity. With the remedial means so patent why should the corrective agency be latent?

The San Joaquin Rate Decision

Peculiar interest centers in the decision of the California Railroad Commission regarding the rates of the San Joaquin Light & Power Corporation. It not only represents the most exhaustive investigation yet conducted as to agricultural power conditions, settling several disputed points, but it will also probably be the precedent for other Western commissions as regards the supply of electric current for irrigation pumping. As certain rules are laid down for the guidance of utilities, a brief summary of the salient features of the decision is of immediate value, discussion on them being deferred until a future issue. The subjects specifically discussed are contracts, valuation and rates.

Most of the decision is devoted to amending the terms of the company's contract with agricultural consumers. In the commission's opinion, an electric utility cannot require a contract as a condition precedent to service, except in unusual cases. The large abnormal investment for agricultural lines justifies a three-year instead of a five-year contract in this case, as also with oil well pumping, mining power and municipal lighting. But no utility can demand a lien on land to guarantee the payment of bills nor require consumers to waive claims for damage caused by service interruption. Neither can the granting of a right-of-way across a consumer's property be demanded before service is given, this being a matter "which should be left to the unfettered bargaining between the consumer and the utility." Furthermore, a farmer may use the full amount of power for other purposes when it is not being used for irrigation if the maximum demand is controlled by a double-throw switch or other approved limiting device.

The commission re-iterated its opinion that the cost of service extensions, consumers' transformers and the relocation of meters should be borne by the utility. It was suggested that payment for existing transformers and meter relocations be made by crediting monthly bills with the value thereof.

The treatment of the evaluation problem, particularly as regards "going concern" value and the valuation of water rights is intensely interesting. In its arguments, the corporation had assumed that its going concern value was at least equivalent to the cost of developing its business, showing that in eight districts this had amounted to $82.98 per consumer and $41.58 per kilowatt of connected load. The commission found that no allowance had been made for the fact that the surplus of later years has amortized the deficit of earlier years and consequently disallowed any going concern value. "The tangible property, however, is being valued as property in successful operation by a going and successful utility. It must not be understood from this decision that when a utility's deficits have not been wiped out, the amount of such deficit must be added as going value, or otherwise, to the amount reasonably allowable for the tangible property. Otherwise the most poorly operated property might be the most valuable for a rate case."

The company had included water right values among its assets. These value were based upon the comparative cost of hydroelectric and steam-electric generation and also on the assumed detriment to lower riparian lands caused by storage of water which might otherwise be available for irrigation. The commission found that the application of the substitutional steam plant method proves that the water rights have a large negative value at present and will so continue until the price of oil is at least fifty per cent in excess of the assumed price of fifty cents per barrel. The commission holds that such a theory, based on varying prices of fuel oil, makes the continuance of a stable rate base impossible. As regards the second point, evidence was produced to show that the beneficial regulating effect of the storage reservoir more than compensates for any water deprivation to lower irrigable lands. Finally it was held that in rate cases no allowance should be made for governmental franchises or permits in excess of the amounts actually paid to the granting public authorities.

The final determination of rates was based on an eight per cent return on the valuation. The agricultural power rate of $50 per horsepower year was reduced to $42.30 and other rates in about the same proportion. Considerable criticism was directed against the company's methods of determining maximum demand. When the revenue from large power and lighting consumers is sufficient, maximum demand meters are justified, but the operating characteristics of ordinary agricultural, power and residence lighting consumers are now so well known that rates may be safely based on the connected load. Maximum demand readings should be for at least fifteen minutes nor should a single reading govern an entire year's bills. It is suggested that a material saving be accomplished by discontinuing the practice of installing meters on strictly flat rate installations.

PERSONALS

Frank Leach, electrical contractor from Fortuna, Cal., is at San Francisco.

W. S. Berry, sales manager Western Electric Company at San Francisco, is at Los Angeles.

H. H. Hoxie of the Electric Railway & Manufacturers Supply Company is in Southern California.

S. V. Mooney, western manager John A. Roebling Sons Co., is on his way to New York, via Seattle, Wash.

H. J. White, of the firm of Keeler-White, has returned to San Francisco from a trip throughout Southern California.

L. H. Baldwin, of the Kellogg Switchboard & Supply Company, is now representing that firm in Los Angeles, Cal.

E. P. Williams, general manager Colonial Electric Division, Colonial Agency Company of Warren, Ohio, will visit the coast very soon.

F. A. Wood, of the Gamewell Fire Alarm Company, is back at San Francisco after a trip in the northern part of California.

E. N. Brown, manager of the Majestic Electric Development Company, San Francisco, will be in the East for the next six weeks.

H. A. Lardner, vice-president J. G. White Engineering Corporation, has returned to the New York office, where he expects to remain some time.

A. J. Myers, Pacific Coast manager Wagner Electric Company of St. Louis, who has been visiting their factories, has recently returned to San Francisco.

C. W. Atkins, at one time with the Electric Maintenance Company, is now in business for himself under the name of the Radio Light Company, at San Francisco.

J. M. Wakeman, general manager of the Society for Electrical Development, has been appointed by Jupiter Thomas A. Wynne, Statesman-at-large of the Jovian Order.

W. J. Davis, Jr., Pacific Coast engineer General Electric Company, and **John Hood,** local engineer at San Francisco, are visting the company's factories in the East.

J. T. Whittlesey, electrical engineer, Universal Electric & Gas Company, is attending a convention of American S. &. M. Engineers in New Orleans. He will return to San Francisco on the 18th of this month.

W. D'A Ryan, illuminating engineer General Electric Company, left San Francisco for the East this week after completing arrangements for the illumination of Market street with ornamental lighting standards.

Geo. R. Murphy, Pacific Coast manager for the Electric Storage Battery Company, has recently returned to San Francisco, after an extended business trip throughout the Northwest.

E. M. Cutting, Pacific Coast representative of the Edison Storage Battery Company, is returning to the coast from a business trip to the home factory by way of Montana, Idaho and Salt Lake.

F. J. Quinn of the Manhattan Electrical Supply Company, has returned to San Francisco from Fresno and Southern California, after having made an extended trip throughout the northwestern territory.

J. C. Zancker of the Zancker Electric Sign Company of Portland, Oregon, has recently made arrangements with the Federal Sign System (Electric) of San Francisco to be their representative in that territory.

Edwin B. Pike, Pacific Coast manager Jefferson Glass Company, of Follansbee, West Virginia, has returned to San Francisco after an extended trip to the factories covering the territory between Portland and West Virginia on his trip east and the southern states on his return.

Clyde B. Aitchison, chairman of the Oregon Public Service Commission has accepted appointment as chief of the valuation department of the National Association of Railroad Commissioners at Washington, D. C. He will resign after the primaries next month. Republicans who have filed their candidacies for the Eastern Oregon nomination for commissioner are H. H. Corey, secretary of the commission, of Baker; Robert Service of Baker, James B. Kyle of Stanfield, Ed. Wright of La Grande, and John P. Rusk of La Grande.

James M. Barry, chief of the Department of Electricity, San Francisco, has placed his offices at the disposal of a committee now drafting a joint pole agreement. **E. J. Kendall,** of the Great Western Power Company, is presiding at the meetings, and **Frederick Smith,** of the Pacific Telephone & Telegraph Company, is acting as secretary. The committee includes: **A. R. Thompson, P. J. Wilson** and **S. J. Lisberger,** of the Pacific Gas & Electric Company; **E. W. Beardsley,** Great Western Power Company; **James L. Ord,** Western Union; **H. F. Jackson,** Sierra & San Francisco Power Company; **Samuel L. Foster,** United Railroads; **Paul J. Ost,** Municipal Railway; **Alfred K. Harford,** Universal Electric & Gas Company; **W. T. Teague,** Pacific Telephone & Telegraph Co., and **A. R. Kempston,** Department of Electricity. It has been decided that it would be best in this city to let poles already up remain the property of the companies that have erected them, and to have these companies grant perpetual easements to other companies. Joint ownership will be provided for where several companies wish to erect new poles at the same time.

MEETING NOTICES.

Los Angeles Jovian Electric League.

President Henry F. Holland being absent in San Francisco, Mr. Alan E. Morphy took charge of the meeting April 5th, and with his unusual brilliancy and good humor quickly turned the luncheon into a real party. Ross B. Mateer, commercial agent, The Southern Sierras Power Company, who was to have been chairman of the day, was absent on account of the death of his father, and K. E. Van Kuran, district manager Westinghouse Electric & Manufacturing Company, acted in his stead. A delegation from Riverside, representing The Southern Sierras Power Company, was heartily welcomed and short talks were made by Assistant Treasurer A. S. Cooper and Purchasing Agent H. R. Day, the real orator of the day being L. B. Potter, attorney and counsel of the company, whose keen wit and humor made a very favorable impression. His subject was "Co-operation."

Electrical Development and Jovian League of San Francisco.

Advertising was the subject of an interesting meeting of the League on April 5th, C. H. Tallant, advertising representative of the General Electric Company, being chairman of the day and Fred Nelson, advertising manager for O'Connor, Moffatt & Company, the speaker. Mr. Nelson commended the excellence of the slogan "Do it electrically," as the nucleus for a great publicity campaign. He showed that the cost of advertising, in general, is absorbed in the greater distribution and consequently lessened costs of manufacturing thus produced. He stated that advertising is the most direct line of communication between the seller and the buyer from manufacturer to jobber, from jobber to dealer, and from dealer to consumer. A number of successful advertising campaigns were specifically cited as showing their effect in increasing the frequency of turnover, and consequently of profit. He advocated a co-operative campaign on bill boards, in newspapers and by mail and suggested that the advertising appropriation bear a direct ratio to the gross sales. He also advised that such a campaign be done under the direction of an expert advertising man. His remarks were concluded by a statement that the success of any association is dependent

upon the definiteness of the reason for its existence and that the mission of this league should be to tell people how to economize by using electricity. At the suggestion of S. V. Walton, the secretary was instructed to advise various civic organizations of the league's willingness to provide speakers on electrical subjects.

Pacific Division of the American Association for the Advancement of Science.

During the past year a general association of scientific interests on the Pacific Coast supported by affiliations with a number of Pacific Coast scientific societies has been effected under the auspices of the Pacific Division of the American Association for the Advancement of Science. The first meeting of this Division has been appointed for San Diego between the dates, August 9 and 12, 1916. This will be an event of especial significance to Western scientists because it will be the first of a series of similar meetings which it is planned to hold annually in the various educational centers of the Coast, and because it occurs in a region which presents many interesting features of geology, archaelogy, botany and zoology. The officers and members of the executive committee is whose hands are the general plans for the San Diego meeting are representatives of several branches of science: President, W. W. Campbell, Lick Observatory, Mount Hamilton, California; Vice-President, D. T. MacDougal, Desert Botanical Laboratory, Tuscon, Arizona; Secretary-Treasurer, Albert L. Barrows, University of California, Berkeley. Executive Committee—D. T. MacDougal, chairman, Desert Botanical Laboratory, Tuscon, Arizona; W. W. Campbell, ex-officio, Lick Observatory, Mount Hamilton, California; Edward C. Franklin Stanford University California; Theodore C. Frye, University of Washington, Seattle; C. E. Grunsky, San Francisco, California; George E. Hale, Mount Wilson Solar Observatory, Pasadena, California; Vernon L. Kellogg, Stanford University California; A. C. Lawson, University of California, Berkeley; E. P. Lewis, University of California, Berkeley. Among the important addresses to be given at the San Diego meeting of the Pacific Division of the American Association will be that of the president of the division, Dr. W. W. Campbell, director of the Lick Observatory of the University of California, Mount Hamilton, entitled, "What We Know About Comets." Two other general addresses will be given by Dr. F. F. Westbrook, president of the University of British Columbia; by Dr. Barton W. Evermann, director of the museum of the California Academy of Science.

Washington A. I. E. E. Meeting.

A meeting of the American Institute of Electrical Engineers will be held at Washington, D. C., on Wednesday, April 26, 1916, under the auspices of the Washington section and the committee on development of water power. Headquarters will be at the New Willard, and through the courtesy of the hotel management ample facilities have been put at the institute's disposal. Two sessions are to be held, the first beginning at 2:30 o'clock in the afternoon, and the second at 8:15 o'clock in the evening, both devoted to the specific question of water power development as related to national industrial efficiency and preparedness.

This meeting has been suggested by the committee on development of water power, which sees further opportunity for service to the nation by directing the attention of the public and of congress to the fundamental engineering and economic principles that underly the water power question and which must be taken into account if hydroelectric development is to be encouraged and stimulated, with a corresponding effect on the development of the great electrochemical and similar industries which are essential to the industrial independence of the nation.

At the present time congress is considering the enactment of legislation intended to remove some of the legal obstructions which in the past have operated to deter capital from investment in hydroelectric enterprises, and it would therefore seem to be a peculiarly opportune moment for the institute to be of service. as will be noted from the program which follows, it has been sought to correlate several of those phases of hydroelectric development which are of peculiar and perhaps unusual importance at the present time, while the standing of the authors who have consented to prepare papers insures adequate presentation.

The program for this meeting, as at present arranged, is as follows:

1. Address by President John J. Carty.
2. "Electrochemical Industries and Their Interest in the Development of Water Power," by Lawrence Addicks.
3. Water Power Development and the Food Problem," by Allerton S. Cushman.
4. "The Relation of Water Power to Increased Transportation," by L. B. Stillwell.
5. "The Relation of Water Power to the National Defense," by W R. Whitney.
6. "The Water Power Situation, Including Its Financial Aspect," by Gano Dunn.

Oregon Electrical Contractors' Association.

The Oregon Association of Electrical Contractors and Dealers, have been holding weekly meetings, but at the last meeting it was decided to reduce the same to two meetings a month and same will hereafter be held at the Electric Building, on the second and fourth Wednesday evenings of each month, the first meeting in each month to be a purely educational meeting and a competent committee consisting of Messrs. J. R. Tomlinson, A. C. McMicken and Mr. Wills, who promise that there will be something doing all the time. The second meeting of the month will be devoted to the business of the association. At the meeting held on March 22d an election of two additional vice-presidents was had, owing to the membership of this district having reached 36 members and Mr. J. H. Sroufe and Mr. Edward Pierce were elected to same. The membership from out the state is increasing; the following applications were received since last meeting: Hunter Electric, Eugene; The Dalles Electric Works, The Apple City Electric Company of Hood River, and Cole & Cummings of Corvallis. The spirit of co-operation is manifest throughout the membership and all believe that this association will accomplish its aims and objects. There has been more that forty already built houses in the city wired under the campaign now in effect and that in the first 15 days.

California Association of Electrical Contractors and Dealers.

The regular quarterly meeting was held Thursday, April 6th, at Oakland, Cal. After disposal of the regular routine business the question of the meeting place for the annual convention was taken up, with the result that Santa Cruz was selected as the convention city, provided the resort hotel is in operation this season. Should this fail to open the city of Stockton was selected as an alternate.

Request was also made that the chairman of the various local sections of the state association be prepared to submit progress reports at future quarterly meetings. It was also decided to keep in close touch with the working of the Federal Trade Commission and secure complete reports of that body's work along cost find and accounting systems for small retailers. Some forty members attended the afternoon session, which adjourned at 5 p. m. to permit attendants to prepare for the open meeting of the evening which was called for 7 o'clock.

W. H. Gribble presided as toastmaster at the banquet in the evening, 97 contractors and jobbers being present. The principal speaker was J. J. Donovan, city architect of Oakland, who spoke on co-operation between the architect and contractor, telling of his own practice in requiring general contractors to submit the list of sub-contractors in order to prevent the peddling of bids. This courtesy carries with it

an obligation on the part of the sub-contractor to deal fairly and squarely with the architect. He urged the contractor to provide a fair margin of profit and suggested the necessity of educating owners to realize the importance of concealed work, such as electrical equipment.

F. E. Newberry spoke briefly of the necessity for contractors carrying on their business in a businesslike way and also commended association meetings. He stated that it had become the duty of contractors to be careful in adding proper allowance for overhead and a legitimate profit to the cost of labor and material.

Geo. B. Furniss, assistant manager of the Pacific Gas Electric Company at Oakland, spoke of the value of associations in development of opportunity. Brief remarks along the same lines were also made by W. S. Berry and C. F. Butte. W. L. Goodwin urged the value of association membership and cited the Federal Trade Commission's commendation of trade associations in general. He said electrical contractors seemed to have a wonderful faculty for not making money. He condemned the National Board of Fire Underwriters for not discriminating between grades of material and suggested that the architects should have a committee to establish quality standards. C. E. Wiggin urged the dealers to energetically follow up sales prospects and then to add a fair profit in order to successfully conduct their business.

S. V. Walton, commercial manager of the Pacific Gas & Electric Company, briefly recounted the progress of the lamp socket device campaign being conducted co-operatively with the jobbers. This is being modified so that all sales will hereafter be made through the dealers, as the Pacific Gas & Electric Company is convinced that dealers are able and capable of handling appliances at retail. A similar policy as regards ranges will probably be inaugurated in the near future. The central station will encourage dealers to sell ranges in districts where there are capable dealers and will confine its selling efforts to districts where there are no dealers. It is likely that other power companies will do likewise. W. L. Goodwin prophesied that $70,000 worth of ranges will be sold in the western territory during the next 12 months and that this amount would double and quadruple in the second and third year respectively, so that four years from now dealers can figure on handling $500,000 worth of ranges annually.

NEWS OF CALIFORNIA RAILROAD COMMISSION.

The commission has authorized the Western States Gas & Electric Company to withdraw from the Girard Trust Company $9,114.47 for expenditures.

The Valley Natural Gas Company has applied to the commission for authority to execute a deed of trust to the Anglo-California Trust Company to secure a bonded indebtedness of $2,000,000 and to issue $378,000 par value of bonds secured by it. The company seeks to buy the properties of the California Natural Gas Company.

The Riverside Home Telephone & Telegraph Company and the Pacific Telephone & Telegraph Company have filed with the commission an application for the authority for the Riverside company to sell its property to the Pacific company for $245,382.65.

The Reedley Telephone Company, a sub-licensee of the Pacific Telephone & Telegraph Company, has applied to the commission for authority to issue 951 shares of its capital stock at 90 cents a share.

The commission has issued an order denying the supplemental application of the Marin County Electric Railways for authority to sell stock to other than bona fide residents and property owners of Mill Valley. The commission authorized the company to issue $67,000 worth of stock but only in the light of promotion enterprise with all the responsibility for loss as gain. The commission will not permit the securities to be sold broadcast to small investors.

TRADE NOTES.

S. Gelber Electric Works, San Francisco, announce two jobs, one at 3322 Fillmore street and one at 1858 Filbert.

The Universal Gas & Electric Company is active, erecting poles in the Richmond and northern Fillmore District, San Francisco.

The Holabird-Reynolds Company of San Francisco have received their Hotpoint electric ranges and had a satisfactory demonstration.

The Schwartz Electrical Company, 750 Clement street, announce a fixture and wiring job at Page and Scott streets, San Francisco.

The Meyers Electric Company, 2014½ Sutter street, has a wiring job for the Geo. W. Brown residence, on Egbert street, San Francisco.

Hetty Bros., San Francisco, are now working on the Christian Science Church at Haight and Ashbury streets and the Episcopal church at Fulton and Fillmore.

The Buzzell Electric Works of San Francisco has just finished a wiring contract for the Mission Masonic Lodge, also a contract of $2000, wiring the Bemis Bros. Bag Company's building.

The Majestic Electric Development Company of San Francisco is, in spite of the war, making shipments of its products to Europe and Australia. If anything, they say, their business is better since the war began.

Haller-Cunningham Company, 428 Market street, electrical dealers and wireless specialists, recently finished a wireless installation on the steamer "William Chattham," owned by the Loop Lumber Company, San Francisco.

The General Electrical Construction Company, San Francisco, has recently taken the wiring contract for the Moreshead Apartments, California and Mason streets, opposite the Fairmount, as well as that for the Parsonage School and Convent at Twenty-ninth and Church.

Macdonald & Kahn, contracting engineers at San Francisco for the Zellerbach Paper Company, announce a contract for that company in which everything will be electrically driven with entire new equipment. His place covers a space 137 by 300 ft. and is six stories high.

The Great Western Power Company is building a new power substation on Bush street, San Francisco. New offices for the steam department and electric range department have been opened at 511 Sutter street, the former quarters of the United Power Company. The steam department is in charge of Chas. Murphy and the range department in charge of E. A. Wilcox.

Levy Bros., San Francisco, are doing the wiring for the Martini Apartments on Telegraph Hill and six different houses out on Douglass and Jersey streets, San Francisco. The point notable in these contracts is that many of the old homes of San Francisco, which have never been wired, are now being wired on account of the "Wire your home" campaign.

Here is a good one, and he admitted it too: A San Francisco uptown electrical contractor said that a friend of his had a job of wiring to do and opened up the bids showing where one man bid $155; he had bid $115, and one of the downtown firms had bid $90. He said he was favored with the bid for $115 (because he knew the party) and then when the job was finished he had lost $60 on the job.

E. L. Byington, San Francisco, electrician, who makes a specialty of colored light and decorations, has just finished two contracts, one for the Bristol Cafe on Fillmore street and the other for the Campus Cafe, 1518 Fillmore street. The last named was contracted for by the Belmont Electric Company, 2238 Fillmore street. V. Fasono, manager of the Belmont Electric Company, is one of the few men who is satisfied with electrical conditions. He said he had all the work he can do and is not losing any money.

NEWS NOTES

ILLUMINATION.

LOVELOCK, NEV.—Plans are underway by which the village will be lighted with electricity.

WINSLOW, ARIZ.—The Winslow Gas Light & Heat Company is preparing to erect a gas plant in Winslow.

SALT LAKE CITY, UTAH.—The contract for lighting the state capitol grounds has been awarded to Eardley Bros., for $9500.

HUNTINGTON BEACH, CAL.—The city trustees have directed A. R. Lott, manager for the Pacific Light & Power Company, to install eleven new street lights here.

BAKERSFIELD, CAL.—City Manager Morgan after investigating the electrolier lighting system in Fresno, estimates that a similar system could be installed here for $19,000.

WILMINGTON, CAL.—A petition from the Wilmington Chamber of Commerce, asking for electric lights in the residence district of Wilmington, has been referred by the city council to the board of public works for its attention.

SAN RAFAEL, CAL.—The Pacific Gas & Electric Company of San Rafael has purchased the Richard Hotaling property on the southeast corner of Fourth and E streets as a site for a one story reinforced concrete office building to cost $24,000.

PASADENA, CAL.—Calling for bids for $15,000 worth of extra equipment for the municipal light and power plant, the city commission has undertaken to put the plant in the position to supply East Los Angeles and Highland Park with current until the aqueduct plant is completed.

OREGON CITY, ORE.—A special meeting of the city council this month which will be devoted to discussing the practicability of a municipal light and power plant operated by power from the falls is being considered by Mayor Hackett, who urges that the city generate electricity for street lighting and for commercial light and power.

ASHLAND, ORE.—Many customers of the Ashland municipal electric lighting system are planning to install porch lights as a result of action by the city council in offering free current for porch lights to every resident user in Ashland. The Ashland municipal plant has paid a profit since its installation and since the city took over the distribution system of the California-Oregon Power Company in Ashland an additional clear profit of about $700 a month has been added to revenue from the electrical department. Forty new street lights, 120 decorative lights for the new Hotel Oregon and finally this order of free current for porch lights and the ready response of consumers promise to make Ashland one of the most brilliantly lighted cities in Oregon.

TRANSMISSION.

WALLACE, IDAHO.—Conferences have been held by representatives of the Reindeer-Queen, Carney Copper and Carbonate Hill Mining Companies with a view to the erection of a power plant that will supply electrical energy for the three companies. The Carney Copper is preparing to install a compressor.

SAN FRANCISCO, CAL.—Representatives of telephone, telegraph and electric light and power companies and of other corporations that maintain poles and overhead wires in this city attended a meeting of the board of works a few days ago, at which a joint pole agreement was proposed. An agreement of this character is in effect in Oakland, Los Angeles and other Pacific Coast cities.

PORTLAND, ORE.—The Rasmussen-Grace Company, Bates Building, has received a commission from the Hawley Pulp & Paper Company to prepare the plans and specifications for the 1000 horsepower power plant at the Oregon City mill. The plant will be situated in the river bed at the falls and will be housed in a structure of reinforced concrete, which will contain a number of unusual features, as at times of high water the plant will be submerged, and must be kept in operation while in this condition.

LOS ANGELES, CAL.—The directors of the San Joaquin Light & Power Company have authorized the expenditure of $500,000 for the completion of the construction of power house No. 2 in Crane Valley, upon which approximately $250,000 was expended three years ago up to the time work was held up owing to financial conditions. Tunnels, ditches and the intake have been completed. The power house is located between No. 1 and No. 3 and is a mile and a half south of North Fork. It will utilize the fall of water between the two plants, and develop 3000 kw., as compared with 18,000 kw. developed by power house No. 1 and 2000 developed by power house No. 3.

TELEPHONE AND TELEGRAPH.

SALMON, IDAHO.—The Challis-Pahsimarol telephone has decided to extend its lines to connect up with the Watkins system.

NEWPORT, WASH.—The Calispell Telephone Association has asked for a franchise to construct telephone lines along the roads in Pend Oreille county.

SAUSALITO, CAL.—A tentative application from the Pacific Telephone & Telegraph Company for a franchise in Sausalito, has been referred to the street committee.

WINNEMUCCA, NEV.—The line of the Utah, Nevada & Idaho Telephone Company is to be extended to Kennedy from the Goldbanks Quicksilver Company in Pleasant Valley.

CLOVIS, N. M.—It has been announced that the new telephone exchange building to be erected here by the Mountain States Telephone Company will cost approximately $30,000.

NAPA, CAL.—Upon application of Benjamin F. Stetson for a telephone franchise in supervisor districts 2 and 5, the clerk was ordered to advertise for bids, said franchise to be sold on May 10th.

PORTERVILLE, CAL.—Woodville people who want telephone connections with Porterville have taken up the matter with the Pacific Telephone & Telegraph Company, Latimer & Son, who are engaged in building a farmers' line and the Porterville Businessmen's Association.

MARSHFIELD, ORE.—Bids for erecting the proposed government wireless radio station at Marshfield, Ore., will close on May 2. The work involves several small buildings and two wood towers. Plans may be obtained from Navy Pay Office, First National Bank Building, San Francisco.

SANTA BARBARA, CAL.—An ordinance has been adopted consenting to the assignment by the Home Telephone & Telegraph Company of Santa Barbara of a franchise to the Santa Barbara Telephone Company, which was granted to F. F. Graves on August 20, 1903, and was transferred by him on May 10, 1904, to the Home Company.

SALT LAKE, UTAH.—A building for a new telephone plant to serve the suburban districts of Salt Lake City is planned by the Mountain States Telephone & Telegraph Company. The new plant will cost $200,000 and will be built on a site convenient to both Murray and Midvale. According to the plans of the company the new plant will be completed during this year.

PASCO, WASH.—The Pacific State Telephone Company has taken charge of the local telephone exchange, which was purchased from the Twin City Telephone Company last week for $12,000. It is the intention of the purchasers to make

many improvements, including a modern switchboard and laying of underground cables. The Twin City Telephone Company has been operated by the Kling Brothers for about ten years. Richard Kling, manager of the old company, will probably move to Montana, where he has property interests in and around Great Falls.

PORTLAND, ORE.—The Home Telephone Company is to pay a $500 fine and in the future to follow the provisions of the ordinance regulating the installation and maintenance of overhead wires. The decision comes as the result of suggestion by Federal Judge Wolverton that the company and the city attempt to settle their grievances concerning the enforcement of the ordinance. The ordinance was passed in 1909. It specifies how telephone wires and guy wires are to be installed. The ordinance was passed at the instance of the electric linemen and was said to be in the interests of safety. In 1911 the telephone company was fined $500 by Judge McGinn for alleged violation of the ordinance. The company then took the case to the federal court seeking to enjoin the city in its enforcement of the ordinance. After hearing arguments Judge Wolverton suggested that the case be settled out of court. Officials of the company met with Commissioner Daly and representatives of the linemen's union. Under the arrangements the company is to have 80 per cent of all of its wires installed in conformance with the ordinance within four years, and in cases where real hazardous conditions exist the wires are to be changed within one year. In addition the company is to pay the $500 fine assessed by Judge McGinn.

TRANSPORTATION

SPOKANE, WASH.—A franchise to operate and maintain street car lines from Thirty-third to Thirty-eighth avenues, on Grand Boulevard, was asked of the city council by the Spokane Traction Company.

SPOKANE, WASH.—The Milwaukee railroad eventually will be run by electricity from Harlowtown, Montana, through Spokane to the coast, as announced by officials of the company. It is stated that the second unit will be completed by fall, and that the third unit will extend to Spokane.

INDEPENDENCE, ORE.—The Southern Pacific Company is making preparations to electrify the lines through this city to Corvallis. The company has asked the city council for a franchise for poles and wiring along the line of the main track on Second street.

SPOKANE, WASH.—An ordinance granting to the Spokane & Inland Empire Railroads Company the right to build, construct, equip, maintain and operate a single or double track electric railway system upon certain streets of the city of Spokane, Wash., is now before the council.

SACRAMENTO, CAL.—A plan of reorganization for the Northern Electric, now in the hands of a receiver, has been agreed upon by a majority of the bondholders, according to C. F. Humphrey, attorney for the latter interest. Following a meeting of the reorganization committee the new plan is to be presented to the new committee for ratification. Details of the plan have not been made public.

WATERWORKS.

PAYETTE, IDAHO.—The commercial club is discussing the proposition of securing an up-to-date filtration system for the city waterworks.

WHITTIER, CAL.—A proposal to issue $111,000 in bonds for the improvement and development of the municipal water system was defeated at a recent election.

TURLOCK, CAL.—Trustees Weaver and Osborn have been appointed a committee to attend to the matter of preparing plans and specifications for a water plant.

HARLOWTON, MONT.—Bids will be received until April 20 by S. K. Campbell, city clerk, for construction of a municipal water system. Estimated cost is $25,000.

TWIN FALLS, IDAHO—The $80,000 worth of water works bonds have been sold to the Lumberman Trust Company of Portland, Ore., at a premium of $2488. The money will be used in the development of the system.

WOODLAND, CAL.—An election has been called for May 9th to vote on a bond issue of $66,000; $6000 for sewer extensions, $55,000 for a municipal water plant, and $10,000 for a municipal ice plant. C. E. Arnold is city engineer.

PALO ALTO, CAL.—The board of public works has adopted plans and specifications for water and sewer main extensions on certain streets that are to be paved and has authorized the advertising for bids to be opened April 17th.

GREAT FALLS, MONT.—Bids will be received until May 16, for the purchase of $150,000 worth of water bonds, to be issued in denominations of $1000, bearing 4½ per cent interest, payable in 20 years from date, and redeemable ten years from date.

WOODLAND, CAL.—The city bond election will be held on May 9th. The amount of bonds to be voted on will be $6000 for sewer, $55,000 for water and $10,000 for a municipal ice plant. The bonds will bear 5 per cent interest and will run for 15 years.

TUCUMCARI, N. M.—The electric light company is putting down cement floors and foundations preparatory to installing new machinery for pumping city water. The new machinery and equipment will be capable of pumping about 200,000 gallons per day.

SANTA BARBARA, CAL.—Negotiations for the purchase of the Montecito Valley Water Company by the city for $20,000 were discussed at a meeting of the water commissioners, city council and owners of the company recently, and it is probable that the matter will be put before the council for formal action shortly.

HEMET, CAL.—Practically four miles of 26 in. main flumes are being replaced by the Lake Hemet Water Company, and the entire system will be thoroughly overhauled. The total cost of repairs to the system is estimated between $65,000 and $75,000. A large portion of this expense is made necessary by the change of grade of the flume line.

BOISE, IDAHO.—The state land board has approved the plan to increase from 30,000 to 40,000 acres to be irrigated by the Wichahoney Land & Water Company. The increased cost is also granted from $750,000 to $1,256,000. The state engineer reports that the company has sufficient water rights to irrigate more than 40,000 acres. It is expected that work will be started at once on the project.

BILLINGS, MONT.—Bids have been called by the commissioners of Yellowstone county for the digging of wells and installing a water system at Broadview, Mont., and the grading of streets incident to installing the water system. The work includes digging wells, laying water supply lines, building elevated tank, installing pump house and distributing system.

Wanted and For Sale

The rate for advertisements in this column is $1.00 per insertion for 25 words or less; additional words 2 cents each, payable in advance. Remittance and copy should reach this office not later than Monday noon for the next succeeding issue. Replies may be sent in care of the Journal of Electricity, Power and Gas, Crossley Building, San Francisco.

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